

CLAIMS

We claim:

1. A method of preparing a xylene product comprising:
 - (a) providing a reactor containing a non-steamed, phosphorus-treated ZSM-5-type zeolite catalyst;
 - (b) contacting the catalyst with a toluene/methanol feed and a cofeed of hydrogen under reactor conditions suitable for the methylation of toluene; and
 - (c) introducing water cofeed into the reactor during the methylation reaction under conditions that provide substantially no structural aluminum loss of the catalyst from such introduction of water.
2. The method of claim 1, wherein:

the cofeed water is introduced with the initial feed.
3. The method of claim 1, wherein:

the cofeed water is introduced after the toluene methylation reaction has started.
4. The method of claim 1, wherein:

the cofeed water is fed into the reactor at from about 0.2 mole to less than about 10 moles water per mole of HC feed.

5. The method of claim 1, wherein:

the cofeed water is fed into the reactor at 0.3 mole to about 7 moles water per mole of HC feed.

6. The method of claim 1, wherein:

the reactor has a catalyst bed inlet temperature maintained at less than 700 °C.

7. The method of claim 1, wherein:

the phosphorus-treated ZSM-5-type zeolite catalyst has a total phosphorus content of from about 0.01 g P/g zeolite to about 0.15 g P/g zeolite.

8. The method of claim 1, wherein:

the method provides a xylene product having a para-xylene content of at least 80% by total moles of xylene.

9. The method of claim 1, wherein:

the toluene/methanol feed has a toluene/methanol molar ratio of from about 1:2 to about 10:1.

10. The method of claim 1, wherein:

the ZSM-5-type zeolite catalyst is treated with at least one of phosphoric acid and ammonium hydrogen phosphate.

11. The method of claim 1, wherein:

the reactor has a catalyst bed inlet temperature that is maintained from about 400 °C to about 600 °C.

12. The method of claim 1, wherein:

the catalyst has a silica/alumina mole ratio prior to phosphorus treatment from about 25 to about 300.

13. The method of claim 1, wherein:

the catalyst is a bound catalyst.

14. A method of preparing a xylene product comprising:

providing a fixed-bed reactor containing a phosphorus-treated ZSM-5-type zeolite catalyst having a total phosphorus content of from about 0.01 g P/g zeolite to about 0.15 g P/g zeolite and a silica/alumina mole ratio prior to phosphorus treatment from about 25 to about 300;

contacting the catalyst with a toluene/methanol feed and a cofeed of hydrogen under reactor conditions suitable for the methylation of toluene; and

introducing water into the reactor during the methylation reaction in an amount of from about 0.2 to less than about 10 moles of water per mole hydrocarbons under conditions that provide substantially no structural aluminum loss of the catalyst from such introduction of water to produce a xylene product having a para-xylene content of at least 80% by total moles of xylene and wherein the catalyst bed inlet temperature is less than 700 °C.

15. The method of claim 14, wherein:

the water is introduced with the initial toluene/methanol HC feed.

16. The method of claim 14, wherein:

the water is introduced after the toluene methylation reaction has started.

17. The method of claim 14, wherein:

the water is fed into the reactor at a ratio of from about 0.3 to about 7 moles per mole of hydrocarbons.

18. The method of claim 14, wherein:

the toluene/methanol feed has a toluene/methanol molar ratio of from about 1:2 to about 10:1.

19. The method of claim 14, wherein:

the ZSM-5-type zeolite catalyst is treated with at least one of phosphoric acid and ammonium hydrogen phosphate.

20. The method of claim 14, wherein:

the reactor has a catalyst bed inlet temperature that is maintained from about 400 °C to about 700 °C.

21. The method of claim 14, wherein:

the catalyst is a bound catalyst.